The Mongolian Macroeconomic Model

EPSP

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Introduction

The EPSP and the Government of Mongolia have been developing a macroeconomic model of the Mongolian economy. The purpose of the model is to assist the government with examining the possible future performance of the economy and the impact of changes in economic policies and world economic events on the economy. As a result, the model is structured as a multi-sector one that considers the major industries in the economy and the key factors that influence their economic performance. In addition, the need to examine the impacts of government policies has led to the implementation in the model of a linkage between the government and other sectors of the economy. The model is also able to examine the impacts of such international economic events as changes in world oil prices and GDP growth through the inclusion of such variables in the model.

An economic model of the economy is never “finished.” There are always changes in data and economic structures that result in new versions of the model being built. The Mongolian Macroeconomic Model (MMM) is no exception. While a preliminary version of the model has been completed, there is still much work to be done. This work falls under the categories of data development, improvements in model structure to better reflect the structure of the economy, and the conducting simulations with the model to assist with the latter two areas.

The model’s coverage of the economy is complete with the exception of the financial sector. As a result, simulations or forecasts conducted with the model assume accommodating monetary policy and relatively elastic capital flows to meet changes in the current account balance. The model contains an exchange rate equation that attempts to eliminate the current account balance slowly over time. As will be seen below, the exchange rate plays an important part in determining the impacts of the changes examined.

This document provides a description of the current version of the model. This description includes the documentation of the structure of the model, how to use the model, the computer files associated with updating the model’s data base and running the model, and the results of some simulations with the model.

Model Overview

The Mongolian Macroeconomic Model (MMM) is a multi-sector annual model of the Mongolian economy. Similar to other macroeconomic models, quantity adjustments rather than price adjustments clear markets in the short term, while price adjustments play a larger role in the medium to long term. The quantity adjustments include changes in the utilization of capital and labour. Because Mongolia is a small open economy and as such a price taker for many of the products it produces and consumes, changes in wage rates and the exchange rate play the major role in market clearing in the medium to long run.

The model's economy is organized into four broad sectors. Firms employ capital and labour to produce a profit-maximizing output and supply financial instruments. Households consume domestic and foreign products, supply labour, and demand financial instruments. Governments collect taxes, purchase the domestic and foreign products, produce goods and services and supply financial instruments. Foreigners purchase the domestic products, supply the foreign products, and demand and supply financial instruments.

There are three main markets in the model. These markets correspond to the domestic and foreign products, the labour market, and financial markets. Each of these markets is concerned with the determination of demands, supplies, and prices. The markets and their operations are described briefly below.

Product Market

There are two sets of products in the model: domestic products and foreign products. Some of these products such as textiles and clothing are imperfect substitutes, while others such as gold are perfect substitutes.

The products are put to a number of different uses in the model. They can be consumed, used for investment in residential and non-residential forms, held as inventories, or purchased by governments.

The demand for the products comes from these uses. The supply of products originates from domestic production, imports, and inventory change. The foreign products are supplied with a perfect price elasticity of supply. As mentioned above, market clearing in the model comes via both quantity and price adjustments. In the short run, nevertheless, quantity adjustment plays the more important role.

Demand

Consumer demand is determined by the level of real disposable income and real interest rates. The substitution among consumer products is affected by changes in their relative prices and differing income elasticities.

Residential investment demand is determined by the number of households and factors such as real disposable income and interest rates that impact the ability to purchase housing.

Non-residential investment demand is based on firms' factor demands. The demand for capital and thus investment is derived from profit maximization. The long-run desired capital stock is dependent on expected output, the expected price of the product, and the expected user-cost of capital. The expected level of these variables is determined by past levels.

Government demand is determined by the size of the population and discretionary spending decisions on the part of government policy makers.

Exports are demand-determined. As foreign demand and the relative costs of the domestic and foreign products change exports change. Foreign demand is represented by real GDP or other final demand measures for the rest of the world. The exchange rate plays an important role in the performance of exports through its impact on relative costs when measured in a common currency.

The demand for domestic products is based on the above demands and that for imports. **The demand for imports** is a function of domestic economic activity and the relative cost of the domestic and foreign products.

Supply

The supply side of the model contains a consistent integration of output, factor demands, output prices and factor prices. In the short run, the production function for each industry is of a “fixed-proportion” nature – limited substitutability of factors of production. In the medium to long term, the production function behind factor demand and costs is a constant-returns-to-scale Cobb Douglas function.

The factor demand and cost functions are derived under the assumption of profit-maximizing behaviour on the part of firms. Factor demands respond to output and factor prices. Output prices are driven by factor costs through a unit cost function.

A key assumption regarding the supply side of the model is that factors of production are quasi-fixed in nature due to adjustment costs - as a result of such things as career markets for labour - and the passage of time. Firms are assumed to maximize profits subject to the production function. This production structure is expected to hold on average and not on a period-to-period basis. In addition, the marginal conditions associated with profit maximization are expected to hold on average and not in each period.

With quasi-fixed factors of production, firms are assumed to design their production process to enable them to operate over a range of feasible operating rates. They will then choose factor demands and operating rates so as to maximize profits over the expected pattern of operating rates.

The supply of the domestic products is determined through variations in firms' capacity utilization rates. They vary these rates to meet expected sales.

The demand for employment and capital stock are derived from profit-maximizing behaviour on the part of firms given the production technology. Employment and capital adjust to desired demand levels over time. The determinants of capital stock were described above. Desired employment is dependent on the expected level of output and the product wage – wage rate relative to the product price.

Price adjustment in the product market varies in response to factor costs and changes in capacity utilization – given rest of world inflation and the exchange rate. Factor costs influence price determination through a Cobb-Douglas short run unit cost function. A stage-of-processing price model is employed to determine the various final demand price deflators in the model, the key driver of which is the unit cost function. Other key drivers of prices in this framework include commodity prices, import prices, and indirect taxes.

Changes in demand in the model are met by changes in inventories, output, and prices, with almost all of the adjustment coming through quantities rather than prices in the short run.

Labour Market

The determinants of the supply of labour in the model include the size of the population and decisions on the part of the population to participate in the labour market. The demand for labour comes from firms producing the domestic products. As mentioned above, this demand is based on the profit-maximization decisions.

The labour force, which is the measure of labour supply in the model, is determined from source population – population 16 years of age and over – and the participation rate. Population is an exogenous variable. The participation rate is derived from an equation relating this rate the actual and natural rates of unemployment – which captures cyclical movements in the rate – and a time trend that reflects changing socio-economic factors.

Wage inflation is determined from a Phillips curve equation. This equation includes expected consumer price inflation and the difference between the actual and natural unemployment rates. A constant term is included in the equation that incorporates the influence of trend productivity growth and other factors.

Unemployment is determined as a residual from labour force and employment.

Financial Markets

At present the financial sector of the model consists only of an exchange rate equation. In this equation, the exchange rate is assumed to adjust slowly over time in response to changes in the current account balance as a percentage of GDP. Model users are allowed to influence this adjustment to reflect changes in capital inflows. The real cost of funds is included as part of the user cost of capital, but is at present an exogenous variable.

Government

The government sector attempts to incorporate the impact of governments on the economy. The major categories of revenues and expenditures are modelled for the government sector as a whole.

The model considers four major sources of government revenues: direct taxes, contributions to social insurance plans, indirect taxes and other revenues. The latter revenues refer largely to investment income. Direct taxes are further separated into those for persons and business.

Direct and indirect taxes are modelled using a synthetic tax base and an implicitly calculated tax rate for each type of tax. Almost all of these rates are exogenous. Other revenues are computed using equation relating such revenues to economic variables.

Expenditures are divided into those for goods and services and capital formation, transfer payments, subsidies, and interest on the public debt.

Many of the expenditures in the model are modelled in real per capita terms through an exogenous growth rate. Interest on the public debt is determined from an equation that includes the stock of government bonds and the average yield on these bonds.

Workings of the Model

The workings or operation of the models can be separated into that of the short term – the first year of the model simulation – and the long term – the remainder of the simulation period.

Short Term Operation

While the model involves the simultaneous decisions of its various economic actors, its basic workings can be seen from figure shown below.

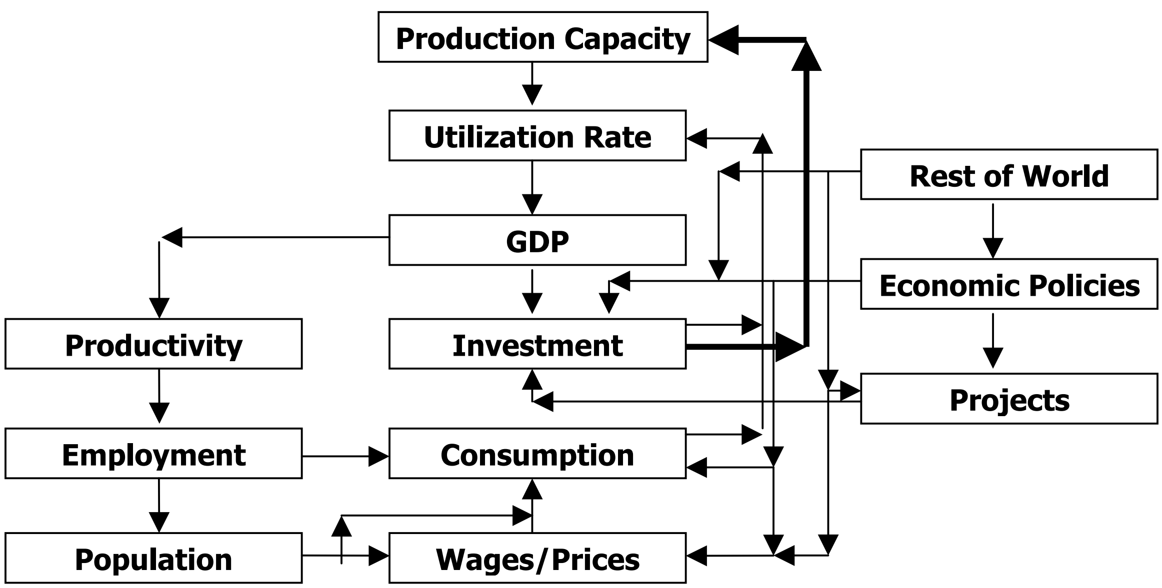
The main outside forces driving the economy are the influences of the rest of the world and economic policies. These two sets of influences shape the views of domestic decision makers including the decision to undertake major projects. Real GDP growth, inflation, and interest rates in the rest of the world drive domestic economic growth through their influence on exports, domestic inflation, the cost of credit and domestic policy formation. Economic policies such as changes in government tax rates and expenditures and monetary policy also impact domestic growth.

Given the external forces and the production capacity of the various sectors in the economy, firms set capacity utilization rates based on expected sales thereby determining real output.

Once real output for each industry is determined, employment for all industries is set through the productivity of labour. Employment when compared with labour force, which is determined by population, then determines wages, which, in turn, drives prices.

Combined with wages, other income, consumer prices and population, employment then determines private consumption. Population also impacts government consumption, as a change in population leads to a change in the demand for government services. Both government consumption and investment are affected.

The increase in real output combined with changes in consumption then changes private investment decisions. The changes in consumption and investment decisions, in turn, lead to changes in capacity utilization rates and output. This type of cycle continues until the one-year solution of the model is obtained.



During this cycle, the monetary authorities intervene in the economy using their policy instruments such as changes in the money supply in attempt to achieve their policy goals such as maintaining low inflation.

Long Term Operation

In the long term, the key determinants of changes in overall economic activity are growth in fixed investment expenditures and productivity growth. The rate of Total Factor Productivity (TFP) growth is determined by changes in technology and modifications to the way in which business is conducted. TFP is an exogenous variable – is set outside of the model. Labour productivity is impacted through TFP and changes in the capital-labour ratio.

Real fixed investment expenditures are the other main driving factor behind economic growth in the model – shown by the larger arrows in the figure. These expenditures are determined for each industry and then summed to obtain total investment expenditures. Such expenditures determine the rate of change in the capital stock, which determines the amount of output growth in the economy.

Investment in industries that are primarily export oriented is set based on views regarding growth in the rest of the world and economic policies affecting the cost of investment and profitability. In industries that serve the latter sectors and the domestic population, investment is determined by the expected amount of capital that will be needed to meet domestic demand growth and the cost of capital.

Major Projects

One of the most difficult tasks in creating economic forecasts is forecasting investment spending. The success of economic theory and its empirical implementation as a means to predict investment is quite poor. There are many reasons for this situation. Investment tends to be lumpy and highly volatile and based on "animal spirits." As a result, economic forecasters tend to supplement the predictions of their models with information such as that provided in surveys of investment intentions.

The MMM is designed specifically to incorporate information on major projects including total investment expenditures and their allocation over time. To include the projects, assumptions must be set for investment, capital stock, employment, and exports. Moreover, the capital stock must be converted to match the average capital-output ratio for the corresponding industry in the model.

In the case of economic projections, the major projects are assumed to be those related to export-oriented activity. The possibility of "double-counting" is encountered when one attempts to include those projects geared to service the local economy. An example of this type of project is the construction of a large shopping centre. While the impact of the project can be accurately incorporated in a projection in an impact sense, there is the possibility that the model has already incorporated the project in the projection.

The reason for this situation is that the demand for the shopping centre's production is based on the performance of the local economy, which the model's equations should already be capturing, at least to a large extent. How does one separate the announcement of this project from investment being put in place by the model's investment equations? This is an important criticism of the use of project information in models. Who is to say that the model is not already incorporating needed investment and including projects may simply lead to the double-counting of investment.

By restricting the inclusion of major projects to export-oriented ones, the double counting problem can be minimized. In very small economies, it is likely that the majority of large export-oriented projects are those that are announced. If this is the case, the model user can restrict the growth of export sales during the period when the projects are taking place.

This approach does not mean that the other project information should not be used. In fact, it is important that this information be used to monitor the performance of investment for industries geared toward serving the local economy. If the project survey suggests that retail and wholesale trade investment spending should grow rapidly over the next few years and the model is not predicting such a situation, then the model user should adjust the investment projections for wholesale and retail trade to produce such a result.

It should be noted at the outset that because the model does not include the industry into which a project falls, the project cannot be included in the model. Any project can be included, but it must be incorporated in the appropriate industry aggregate. For example, an oil refinery falls in the petroleum and coal products industry. The model does not consider this industry. It considers only the manufacturing industry as a whole. As a result, the project must be incorporated through this industry. Adjustments need to be made, nevertheless, to ensure that the project has the correct impact on the manufacturing sector.

Consumer Expenditures

The theory of the determination of consumer expenditures is based on a version of the permanent income model. According to the latter model, under some simplifying assumptions regarding the future path of prices, wages and other income, desired real consumption for the current period, C, is determined as follows:

```
C = C1*YP + C2*R
```

where YP is permanent real disposable income, R is the real rate of interest, and C1 and C2 are coefficients.

The categories of consumer expenditures included in the model with their mnemonics for real expenditures are:

- Household goods, CHHG
- Food, beverages, and tobacco, CFBT
- Clothing and footwear, CCF
- Housing, heating and electricity, CHHE
- Transportation and communications, CTCM
- Other, CO

The use of different categories of expenditures in the model necessitates the inclusion of a relative price term in the expenditure equation shown above.

Real Expenditures

The expenditure equations are based on the assumption that desired expenditures are proportional to desired consumption for the various expenditure categories. Difference in log equations are employed rather than linear equations to allow the imposition of constant income and price elasticities. Model users should be careful when using these equations, since measurement errors in the data or major shocks to the economy can cause the ratio of expenditures to income to shift – for example, expenditures could exceed income. In this situation, the adjustment variables in each equation must be used to get the equations back on track.

The general form of the consumer expenditure equations is shown below for category I:

```
DLOG(C(I)/DP) = ZC(I) + EYC(I)*DLOG(YPD/PC/DP)
+ EPC(I)*DLOG(PC(I)/PC) - ERC(I)*DIFF(RSAV-PCE)
```

where C(I) is consumption for category, DP is population, YPD is disposable income, PC(I) is the own price deflator, PC is the consumer expenditure price deflator, RSAV is the nominal interest rate on saving, PE is expected consumer price inflation, DLOG is the change in log operator, DIFF is the first difference operator EYC(I) is the income elasticity, EPC(I) is the relative price elasticity, ERC, is the real interest rate coefficient, and ZC(I) is a constant growth time trend. The variable ZC(I) can be used to tune the equation for forecasting purposes.

Permanent income in the equations is represented by current real disposable income per capita. The model user is able to impose their own elasticities in the equations. The default value is set at unity for the income and price elasticities. The real interest rate coefficient is set at zero.

Per capita expenditures are modelled for all categories with the exception of housing, heating, and electricity. In the latter category, expenditures and income are measured on a per household basis.

Nominal Consumer Expenditures

Nominal consumer expenditures for a particular category I are determined as:

```
CTG(I) = PC(I) * C(I).
```

Inflation Expectations

The measure of inflation expectations is a simple adaptive expectations measure defined as a moving average of past inflation:

```
PCE = MAVG(3:DLOG(PC)).
```

where MAVG is the moving average function for 3 years, and DLOG is the change in log function.

Residential Construction Expenditures

This sector of the model is concerned with determining the number of households and residential construction expenditures. The main determinants of residential construction expenditures are household formation and changes in the average size and quality of housing.

Households

The number of households, HH, is determined as the product of the household headship rate, RHH, and the size of the population 15 years of age and over, DP15O:

```
HH = RHH*DP15O.
```

The household headship rate is computed on an historical basis as the ratio of households to population 15 and over. It is an exogenous variable.

A distinction is made in the model between the number of households living in GERS and in regular dwelling units. The number of households living in GERS, HHGERS, is determined as the product of the number of households and proportion of households living in GERS, HGERS:

```
HHGERS = HGERS*HH.
```

The number of households requiring regular constructed dwelling units is computed as a residual:

```
HHC = HH - HHGERS.
```

New Housing Requirements

The requirements of constructed housing units, HHCR, are determined as the sum of the change in HHC, new vacancy requirements, and the net demolition of housing units:

```
HHCR = DIFF(HHC) + VRKH*DIFF(HHC[-1]) +
RDKH*HHC[-1],
```

where DIFF is the first difference operator, [-1] is the lag operator, VRKH is the normal vacancy rate for housing and RDKH is the net demolition rate. The first term in the equation is the number of new households, the second term is the change in vacancy requirements, and the third term is the number of net demolitions – the latter variable should be computed using the housing stock in terms of units if data are available.

Housing Stock

The housing stock variable in the model, KH, refers to the average useful living space. This variable is computed according to the equation:

```
KH = (1-RDKH)*KH[-1] + HHCR*RKHALA
```

where RKHALA is the average useful living space per household. The latter variable is an exogenous variable. It is the key variable linking changes in the quality of housing to real residential construction expenditures.

Residential Construction Expenditures

Changes in real residential construction expenditures are determined as a moving average of the change in the growth rate of the housing stock:

```
DLOG(IRB) = MAVG(2:DLOG(KH/KH[-1]))+ ZIRB)
```

where IRB is real expenditures, MAVG is the moving average function, and ZIRB is a growth adjustment variable. The moving average for stock is used to take into account that it takes time to construction housing.

Gross Capital Formation

This sector of the model is concerned with the determination of aggregate capital formation, which includes residential, non-residential investment and inventory change, and the aggregate stock of capital. The determination of investment by industry is outlined in the chapter describing industry behavior.

Total real, IGCF, and nominal, IGCFTG, aggregate gross capital formation are determined as:

IGCF = IRB + INRB + GI + IGCFO + VC

IGCFTG = IRBTG + INRBTG + GITG + IGCFOTG + VCTG

where INRB is real business non-residential investment, GI is government investment, IGCFO is other gross capital formation – livestock investment – and VC is inventory change.

Non-Residential Investment

Non-residential business investment for the economy as a whole is determined as the sum of investment by industry. The equation linking industry and aggregate investment, INRB, is:

```
dlog(inrb) =
dlog(ilv+ioagfh+imi+ima+iut+icn+itsc+itr+ifi+ir
ebs+irh))
```

where the variables on the right-hand-side of the equation refer to non-residential investment for the various industries in the model excluding those dominated by governments.

Nominal investment, INRBTG, is determined as the product of real investment and the price deflator, PINRB:

```
INRBTG = PINRB*INRB.
```

Machinery and equipment investment, IME, is determined as a share of total non-residential investment:

```
IME = SIME*(INRB-KIC+GI)
```

where SIME is the share and KIC is major project construction investment.

Construction investment is determined as a residual:

```
INRC = INRB+GI-IME.
```

Fixed Capital Stock

Aggregate fixed capital stock excluding livestock, K, is determined as:

```
K = (1-RD)*K[-1]+ IRB + INRB + GI.
```

where RD is the aggregate depreciation rate.

User Cost of Capital

The user cost of capital variable, UCC, employed in the model is of the form:

```
UCC = PINRB*(RD +RCF)/(1-(TRYCL+RTRYCH*TRYCH))
```

where RCF is the real cost of funds, TRYCL is the low corporate income tax rate, TRYCH is the high corporate income tax rate, and RTRYCH is the proportion of firms paying the high corporate tax rate.

In the model, the proportional change in the relative cost of capital – based on profit maximization – is a major variable determining investment expenditures. This measure, RCC, is of the form:

RCC = MAVG(3: DLOG(PGDPFC/UCC) + ZRCC

where PGDPFC is the GDP deflator measured at factor cost and ZRCC is an adjustment factor. A moving average is employed here as a measure of the expected change in relative capital costs.

Inventory Change

Inventory change is determined as a residual to ensure the equality of demand and supply in the model:

```
VC = YGDP - YDA – X + IM – GDERES
```

where YGDP is real GDP, YDA is real domestic absorption, X is real exports, IM is real imports, and GDERES is the residual error of estimate for real Gross Domestic Expenditures.

The change in nominal inventories, VCTG, is determined as the product of real inventory change and the GDP deflator, PGDP:

```
VCTG = PGDP*VC.
```

International Trade

The trade sector of the model determines the imports and exports of goods and services and some variables needed to compute the current account balance. The remaining components of the current account balance are determined in other sectors of the model.

While the model is a one sector one and theoretically should include only one import and export equation, a number of different categories of goods and services imports and exports are included to assist model users with producing forecasts and impact studies. Nevertheless, the equations use only aggregate cost measures. The model would need to be a multi-sector one to properly make product by product cost comparisons. Model users can make adjustments to the equations to incorporate their knowledge of the impacts of detailed cost comparisons.

The import and export categories are modelled in real terms. The nominal values are determined as the product of the real values and their respective price deflators.

Imports

The categories of imports included in the model correspond with the industries in the model. The real expenditure categories and their mnemonics are:

- Livestock, IMGLV
- Other agriculture, forestry and hunting, IMGOAGFH
- Mining, IMGMI
- Manufacturing, IMGMA
- Utilities, IMGUT
- Transportation, storage, and communications, IMSTSC
- Trade, IMSTR
- Finance and insurance, IMSFI
- Real Estate and business services, IMSREBS
- Restaurants and hotels, IMSRH

- Other services, IMSOS
- Government services, IMSGS

The equations for goods and service imports assume price-taking behavior on the part of firms and households. The real value of imports is determined by domestic demand for the products and the relative cost of imports.

The equations for real imports of category I, IM(I), are of the general change in log form:

```
DLOG(IM) = DLOG(GDPD(I)) - EIM(I)*RCP + ZIM(I)
```

where GDPD(I) is domestic demand for product I – intermediate plus final demand – EIM (I) is the relative cost elasticity, RCP is a measure of relative cost inflation – foreign relative to domestic – and ZIM(I) is a growth adjustment variable.

In the above equation, the elasticity of imports with respect to demand is constrained to unity, which represents a market share approach to import determination. The construction of the GDPD variables is described later below.

Two import categories are treated in a special manner. The imports of utilities represent electric power imports. They are set using an exogenous growth rate. The imports of government services are assumed to grow like government expenditures on goods and services.

Exports

The export categories included in the model also correspond to the industries in the model. These categories and the mnemonic for real exports are as follows:

- Livestock, XGLV
- Other agriculture, forestry and hunting, XGOAGFH
- Copper mining, XGCOP
- Gold mining, XGGOLD
- Other mining, XGOMI
- Textiles and clothing, XTXCL
- Other manufacturing, XGOMA
- Transportation, storage, and communications, XSTSC
- Trade, XSTR
- Finance and insurance, XSFI
- Real Estate and business services, XSREBS
- Restaurants and hotels, XSRH
- Other services, XSOS
- Government services, XSGS

The domestic goods and services produced in the economy represent a combination of perfect or imperfect substitutes for foreign goods and services. A similar approach is adopted for both types of exports.

The equations for exports of category I, X(I) are of the general change in log form:

```
DLOG(X(I)) = ZX(I)*FACT+ EX(I)*RCP
```

where FACT a foreign growth activity variable, EX(I) is the export price or cost elasticity, and ZX is a growth adjustment variable that can be used to tune the equation or set changes in market shares of Mongolian products.

Foreign Demand and Cost Measures

The measure of foreign activity used for the export equations is constructed from GDP measures for Mongolia's major trading partners. In the current version of the model, the partners are restricted to the Russia, China, Japan, South Korea, the United States and the European Union.

The activity variable is measured in growth rate form, RTYGDP, as:

```
RTYGDP = RXSR*RYGDPR + RXSCH*RYGDPCH + RXSSK*RYGDPSK + RXSEU*RYGDPEU + RXSJP*RYGDPJP + (1-RXSR-RXSCH-RXSEU-RXSJP)*RYGDPUS,
```

where RXSR, RXSCH, RXSSK, RXSEU, and RXSJP are the share of exports going to the Russia, China, South Korea, European Union, and Japan, respectively, RYGDPR, RYGDPCH, RYGDPSK, RYGDPEU, RYGDPJP are the respective real GDP growth rates, and RYGDPUS is US GDP growth rate.

The same activity measure is used for all export categories. Model users can change the impact of this measure in each equation using the ZX adjustments in the respective equations.

The relative cost measure in the model represents the difference between foreign cost or price inflation and domestic cost inflation:

RCP = MAVG(3: RTPGDP-PCH(CQ))

where RTPGDP is foreign costs measured in Mongolia currency and CQ is a measure of domestic unit costs. CQ is discussed below in the description of the determination of wages and prices.

The foreign cost variable, measured in Mongolian currency, is determined in a manner similar to the foreign economic activity measure. This measure in growth rate form is:

```
RTPGDP =
RXSR*(RPGDPR+PCH(EXRMUS/EXRRUS)+RXSCH*(RPGDPCH+
PCH(EXRMUSCA/EXRCHUS)+RXSSK*(RPGDPSK+PCH(EXRMUS
CA/EXRSKUS))+RXSEU*(RPGDPEU+PCH(EXRMUSCA/EXREUR
OUS))+RXSJP*(RPGDPJP+PCH(EXRMUSCA/EXRJPUS))+(1-
RXSR-RXSCH-RXSEU-RXSJP)*(RPGDPUS+EXRMUS),
```

where RGDPR, RPGDPCH, RPGDPSK, RPGDPEU, RPGDPJP, and RPGDPUS are the GDP deflator growth rates for Russia, China, South Korea, European Union, Japan, and the United States, EXRRUS is the

Russia-US exchange rate, EXRCHUS is the China-US exchange rate, EXRSKUS is the South Korea-US exchange rate, EXREUROUS is the Euro-US exchange rate, EXRJPUS is the Japanese Yen-US exchange rate, and EXRMUS is the Mongolian-US exchange rate.

The same relative cost measure is used across all the import and export categories. It measures changes in the general cost structures of the Mongolian economy and its major competitors. These cost structures tend to be dominated by the impacts of labour and capital costs, since inflation in many commodities such as oil under a constant exchange rate is the same across countries.

Current Account

The current account balance, BPCATG, is determined from an identity in the model. It is the sum of the net trade in goods and services, net foreign investment income, and net private and government transfers. The equation is as follows:

```
bpcatg=xtg+xgbprestg-imtg+nxytg+ntrprtg+ntrputg
```

where xtg is nominal exports, xgbprestg is a balance of payments residual for exports, imtg is nominal imports, nxgbptg is net foreign investment income, ntrbpprtg is net private transfer payments, ntrbpputg is net government transfer payments. The latter three variables are exogenous variables.

Industry Sector

The industry sector contains the equations describing the behaviour of industries in the model. Production, employment, and investment decisions are modelled for each of the industries.

The industries included in the model are:

- Livestock;
- Other agriculture, forestry, and hunting;
- Mining;
- Manufacturing;
- Utilities;
- Construction;
- Transportation, storage and communications;
- Trade;
- Finance and insurance;
- Real estate and business services;
- Restaurants and hotels;
- Education services;
- Health and social services;
- Government services; and
- Other services.

The variables modelled for each industry include:

- Real GDP;
- Employment;
- Investment; and
- Capital stock.

The production technology for the non-government sectors is assumed to be of the fixed proportion type in the short run and a Cobb-Douglas constant-returns-to-scale technology in the medium to long run. The basic assumption for industry behaviour is that of profit maximization.

The model user can change factor proportions in the long run through making changes in the growth rates of the productivity of capital and labour over and above those made through changes in relative price of capital and labour variables included in the model.

The determination of the various industry variables is described below using the manufacturing sector as an example. Modifications to the equations are made to allow for the incorporation of the impacts of major projects. As a result, they seem more complicated than is actually the case.

Real GDP

GDP in a particular year is determined by the amount of capacity of the industry – the capital stock – the productivity of that stock – the inverse of the capital-output ratio – and the capacity utilization rate.

The equation for real GDP, YGDPMA, is:

```
ygdpma=krma*kma[-1]/kgma
```

where KMA is the capital stock in the manufacturing industry at the end of the year, KRMA is the capital utilization rate, and KGMA is the normal capital-output ratio. The notation [-1] indicates a one-year lag for the variable.

The above equation states that GDP growth will be equal to the growth rate of the capital stock, the rate of capacity utilization, and the normal capital-output ratio. This approach assumes that capital is the constraining factor in the short-run production function.

The capacity utilization rate adjusts as follows:

dlog(krma)=krmac*dlog((ygdpdma-vasma/(1-ouma)*imgma)/(kma[-1]/kgma)))

where YGDPDMA is domestic demand for manufacturing products – domestic plus imports – in terms of GDP, VASMA/(1-OUMA)*IMGMA is imports of manufactured products in terms of GDP, VASMA is the value-added share for manufacturing and OUMA is the own-use proportion of manufacturing products – the share used by the manufacturing industry itself – and the other variables are defined as above.

The change in GDP demand relative to full capacity output – KMA[-1]/KGMA – drives the utilization rate. As demand rises relative to capacity so does the utilization rate. The coefficient KRMAC reflects the proportion of adjustment that takes place in the utilization rate with an increase in demand relative to capacity.

Capital Stock

The change in the capital stock is equal to net investment. The standard equation to determine capital stock is:

```
KMA = (1-RDKMA)*KMA[-1] + IMA,
```

where RDKMA is the depreciation rate and IMA is investment.

In this equation, the capital existing at the end of a year is equal to last year's capital stock adjusted for depreciation plus gross investment, which includes both replacement and net investment.

While the model uses the above approach to compute stock, some modifications are made to the capital stock equation to allow for the proper consideration of the construction of and start year for new investment projects. The equation is as follows:

```
kma=kma[-1]+ima-rdkma*kma[-1]-inma+knma
```

where INMA is project investment and KNMA is project capital stock.

In this equation, investment during the construction phase of a project is not allowed to enter the actual capital stock – and thus produce real GDP – until the project is completed. Each year INMA is subtracted from IMA so that the capital stock is not augmented. When the project is completed, KNMA is set to the value of cumulative net investment, which causes the actual capital stock to increase and production to take place.

The value of KNMA is set to zero except in the year prior to when the operational phase of the project begins. It should take the value zero in all other future years. The cumulative value of the project stock is captured in the variable KNBMA, which is used in the investment equation described below.

Normal Capital-Output Ratio

This ratio is determined as a weighted average of the old and new capital stock. Under this approach a "vintage" capital approach is used to drive output.

The equation for the normal capital-output ratio is as follows:

```
kgma=(kgma[-1]-kgnma)*(1-rdkma[-1])*kma[-
2]/kma[-1]+kgnma
```

where KGNMA is the capital output ratio for new capital.

The new capital-output ratio is determined in growth rate form as:

```
kgnma=kgnma[-1]*(1+eircc*rcc+rkgnma)
```

where RKGNMA is an exogenous variable representing technological changes that impact the capital-output ratio, RCC is the proportional growth rate in the relative cost of capital, and eircc is the elasticity for relative capital costs. RCC is included to account for changes in the capital-output ratio that reflect changes in the relative cost of capital.

The use of RCC in the new capital-output equation is based on the assumption of profit-maximizing behaviour on the part of firms under a constant-returns-to-scale Cobb-Douglas production function. Under this assumption, changes in the capital-output ratio, other things being equal are unit elastic with respect to RCC. Increases or decreases in RCC would be expected to change the capital-output ratio in the same direction. Setting EIRCC to 0 shuts off the link between capital costs and capital accumulation impact. Its default value is 1.

Investment

The equations for investment are derived from the equations for real GDP and the capital stock. The first equation provides information on the amount of capital required to produce output consistent with expected demand. The second equation takes into account depreciation and the existing size of the stock.

From the equation for real GDP shown above – assuming the capacity utilization rate is constant – the amount of capital required to produce a given level of GDP at a given capital-output ratio can be determined. Expressing this equation in growth rate terms leads to the equation:

```
KGRMA = GDPGRMA – KQGRMA,
```

where KGR is the percentage change in capital stock, GDPGR is the percentage change in real GDPGR and KQGR is the percentage change in the capital-output ratio.

The equation for the capital stock, K, may be expressed simply here as:

```
KMA = (1-RDMA)*KMA[-1] + IMA,
```

where RDMA is the depreciation rate and IMA is gross investment.

Expressing the equation for capital stock in percentage change form yields the following equation:

```
KGRMA = (1-RDMA) + IMA/KMA[-1] - 1.
```

Equating the two equations and solving for I yields the equation:

```
IMA = (GDPGRMA + RDMA + KQGRMA)*KMA[-1]
```

or, replacing KQGRMA with RCC+RKGNMA from above,

```
IMA = (GDPGRMA + RDMA + EIRCC*RCC + RKGNMA)*KMA[-1].
```

In this equation, which is for gross investment required to meet demand, investment is determined by expected manufacturing sales growth, the capital depreciation rate, the growth rate in the relative cost of capital and the exogenous capital-output ratio, and the level of the existing stock of capital.

Investment will be higher if expected output or sales growth increases. A higher depreciation rate implies additional investment, while a higher productivity of capital – lower capital-output ratio – requires less investment.

To include the investment associated with exogenous projects separately, the actual equation employed is a modified version of the equation shown above. The equation for manufacturing gross investment is of the form:

```
ima=(igema+eircc*rcc+zima)*(kma[-1]-knbma[-1])+(rdkma+rkgnma)*kma[-1]+inma
```

where IGEMA is expected sales growth, zima is an investment growth adjustment and the other variables are as defined above.

This equation breaks the contributions to investment into three parts. The first part is non-project investment associated with expected sales and the relative cost of capital, the second part is the amount of investment required to satisfy changes in depreciation and capital-output ratios as discussed above, and the last part is the exogenous project investment.

In this equation, the expected growth in sales must not be applied to the stock of capital associated with projects set outside the model, so the cumulative stock of such capital is subtracted from the total stock.

Expected Sales and Growth

Expected sales refers to the sum of domestic and export sales. Sales are intermediate sales plus final sales. They refer to both domestically and foreign produced products. The latter concepts are used in an input-output model. The structure of this part of the model can be illustrated by considering an economy with only three industry sectors: 1, 2, and 3.

Intermediate demand in an input-output table for industry 1's products, ID1, is determined as:

```
ID1 = a11*GO1 + a12*GO2 + a13*GO3,
```

where GO1-GO3 are gross outputs for the three sectors and a11-a13 are the input shares for each industry – a12 is the proportion of industry 2's gross output that is the output of industry 1.

Assuming that value added or GDP is a fixed share of gross output this equation can be re-written as:

```
ID1 = a11/vs1*GDP1 + a12/vs2*GDP2+a13/vs3*GDP3,
```

where vs1-vs3 are the value added shares – for example, GDP1 = GO1*vs1.

Final demand for industry1's products, FD1, is defined as follows:

```
FD1 = f1c*C + f1ime*IME + f1ic*INRC + X1,
```

where C is consumer expenditures, IME is machinery and equipment investment, INRC is construction investment, X1 is exports, and f1c-f1c are the shares of industry 1's output in the final demand categories.

Total demand for the products of industry 1 – measured in gross output terms – is:

GO1 = ID1 + DD + X1,

or,

GO1 = GDP1/vs1 = a11/vs1*GDP1 + a12/vs2*GDP2+a13/vs3*GDP3 + f1c*C + f1ime*IME + f1ic*INRC + X1.

Solving the above equation for GDP1 yields:

GDP1 = vs1/(1-a11)*(a12/vs2*GDP2 + a13/vs3*GDP3 + f1c*C +f1ime*IME + f1ic*INRC + X1).

The actual implementation of expected domestic sales can be illustrated using the equation for manufacturing. Expected sales for manufacturing products on a GDP basis, ygdpdma, are determined as:

```
ygdpdma=rygdpdma*0.438/(1-
0.1908)*(0.0371*ygdplv/0.839+0.0714*ygdpoagfh/0
.35+0.2492*ygdpmi/0.4+0.0064*ygdput/0.187+0.528
```

```
2*ygdpcn/0.336+0.0038*ygdptr/0.716+0.171*ygdprh
/0.511+0.2553*ygdptsc/0.481+0.0105*ygdpfi/0.434
+0.1567*ygdprebs/0.75+0.0719*ygdphs/0.758+0.107
3*ygdpes/0.587+0.3134*ygdpgs/0.444+0.0759*ygdpo
s/0.6+0.39*cfbt+.34*chhe+0.7500*ccf+0.7500*chg+
0.14*co+0.87*ime+xgma)
```

The coefficients for this equation are computed from input-output tables and other sources where necessary. The variable rygdpdma is an adjustment variable needed to calibrate the equation from the data.

The above equation refers to expected sales for both domestic and foreign firms. Expected sales for domestic firms is computed by subtracting imports of manufacturing products from the equation on a GDP basis.

The expected sales growth equation to drive investment for manufacturing is of the form:

```
igema=mavg(2:dlog(ygdpdma-0.438/(1-
0.1908)*imgma))
```

where the coefficients applied to manufacturing imports convert them to a GDP basis. A moving average is used to extrapolate past to future sales – expectations are adaptive.

A modification is made to this equation to adjust for major project exports. Such exports should also be subtracted since they would add to future investment demand. They are included in overall exports and would, therefore, increase expected sales growth – double counting would result as investment has already been made for them. The equation employed for expected sales growth is:

```
igema=mavg(2:dlog(ygdpdma-0.438/(1-0.1908)
*(xgntxcl+xgnoma+imgma)))
```

Employment

The determination of employment is through real GDP and productivity. Modifications to the employment equation are made to incorporate the impact of projects.

The equation for employment is of the form:

```
ema=dlag(0.7,0.3:(ygdpma-knbma[-
1]/kgma)/prma)+enma
```

where PRMA is labour productivity and ENMA is project operations employment, DLAG is a distributed lag operator and the coefficients are the lag weights. The distributed lag allows for procyclical changes in productivity observed in the economy.

The equation separates the computation of employment into that associated with major project operations and non-project employment. The first term calculates non-project employment. The value knbma[-1]/kgma represents the amount of GDP associated with major projects. It is subtracted from total manufacturing GDP to ensure that major project operations employment is not computed. ENMA adds on major project employment.

Productivity is determined from the equation:

```
DLOG(PRMA) = RPRMA - EERLC*RLC,
```

where RPRMA is an exogenous productivity growth proportion that reflects technological change, RLC is the proportional change in the relative cost of labour and EERLC is the corresponding elasticity. Setting EERLC to zero removes the link between relative labour costs and employment. Its default value is 1.

The inclusion of the relative cost of labour variable is based on the same rationale as for the inclusion of RCC. The RLC variable, which uses the inverse value of the product wage, is defined as:

```
rlc=mavg(3:dlog(pgdpfc/wrptg))+zrlc
```

where zrlc is a growth adjustment variable. A positive(negative) value of rlc, which indicates a reduction in the cost of labour relative to the product price, causes labour productivity to fall (rise) and, therefore, employment to rise.

Special Industries

The determination of some industry variables differs for the construction, education, health and social services, and government services industries.

Construction

In the construction industry the determination of GDP and employment is somewhat different. The equation for GDP in construction is:

```
ygdpcn=rygdpdcn*0.336*(0.75*inrc+0.88*irb),
```

where RYGDPCN is the ratio of GDP to domestic construction demand. The variables following the latter variable represent construction demand.

Employment in the construction industry is determined somewhat differently to allow for project construction employment:

```
ecn=(ygdpcn-rygdpdcn*0.336*kic)/prcn+encn
```

where KIC is major project construction investment and ENCN is project construction employment.

This equation separates the non-project employment from the project employment by subtracting GDP for the construction industry attributable to projects from total construction GDP before dividing GDP by productivity.

Education, Health and Social Services, and Government Services

Real GDP is determined differently for these sectors. For Education and Health and Social Services, real GDP is determined as a function of population growth for target age groups and a per capita spending growth rate to allow for government policy changes that impact spending and GDP growth.

The equation for GDP in Education Services, for example, GDPES, is a growth rate equation of the form:

```
dlog(ygdpes-knbes[-1]/kges)=
rpygdpes/100+dlog(dpes)
```

where DPES is a population variable that reflects the importance of age groups for education expenditures and RPYGDPES is an exogenous growth rate. The latter rate allows the user to incorporate policy changes. Major project GDP is included in the equation, but excluded from changes in DPES.

The population variable is computed as:

```
DPES = WES1*(DP0509+DP1014+DP1519) +
WES2*DP2024
```

where WES1 and WES2 are expenditure weights for the population age groups.

Government current goods and expenditures for education are assumed to grow like GDP in this industry:

DLOG(GCGSES) = DLOG(YGDPES)

An identical approach is employed for health and social services.

Real GDP and capital investment expenditures in Government Services are assumed to grow on a per capita basis at an exogenously set rate. The equation for GDP is:

```
ygdpgs=dp*ygdpgs[-1]*(1+rpygdpgs/100)/dp[-1],
```

where RPYGDPGS is the exogenous growth rate. Similar to the other two industries, goods and services expenditures are assumed to grow at the same rate as GDP.

Investment in government services is assumed to grow on a real per capita basis through an exogenous growth rate:

```
igs=igs[-1]*dp*(1+rpgigs/100)/dp[-1]
```

where rpgigs is the growth rate.

Employment and Labour Force

This section of the model determines aggregate employment, labour force, and unemployment. The determination of employment by industry is discussed in the industry behaviour section below.

Employment

Total employment, E, is the sum of industry employment:

e = eafh+emi+ema+eut+ecn+etr+erh+etsc+efi+erebs+egs+ees+ehs+eos+eres

where the variables on the right-hand-side of the equation are employment for each industry. ERES is a residual to account for any measurement errors.

Labour Force and Unemployment

The labour force equation is an identity linking the participation rate and population of labour force age:

```
LF= LFPR/100*LP.
```

where LFPR is the participation rate.

The participation rate is determined as a function of the gap between the actual, LUR, and natural, LURN, rate of unemployment and a growth adjustment factor, ZLFPR, that reflects social and cultural change. The equation is a change in log function of the form:

```
DLOG(LFPR)= -LFPR1*(LUR-LURN)+zlfpr
```

The deviation of the unemployment rate from its natural rate is included in the equation to account for the discouraged worker effect. As the unemployment rate falls relative to its natural rate, which reflects changes in the economic cycle, the participation rate will rise and vice versa.

The labour force source population is determined as a function of population 15 years of age and over:

```
DLOG(LP) = DLOG(DPOP15O)
```

where DPOP15O is population age 15 and over. Population is exogenous in the model.

Total unemployment and the unemployment rate are computed from the identities:

```
LU = LF - LE

LUR = LU/LF*100.
```

Wages and Prices

This sector of the model is concerned with the determination of wages and the various price deflators in the model. The key wage concept is the hourly wage rate for the economy. The various measures of prices in the model refer to commodities, cost indices, and expenditure deflators.

Wages

The hourly wage rate for employees producing domestic goods and services is defined as labour income per person employed. The private wage rate, WRPTG, is modelled using a Phillips curve. The wage rate in the government sector, WRGTG, is assumed to move in line with private-sector wages, but can be made to deviate from private wage growth by the model user through an adjustment variable.

The private wage rate equation is as follows:

```
DLOG(WRPTG) = ZWRPTG + PCE - WR1*(LUR-LURN)
```

where ZWRPTG is a constant term reflecting left out variables such as trend productivity growth, and WR1 is a coefficient. The variable ZWRPTG should be set in line with assumed long-run productivity growth – ZTFP – to ensure that real wage growth reflects improvements in productivity.

The equation for the government wage rate is:

```
DLOG(WRGTG) = DLOG(WRPTG) + ZWRGTG
```

where ZWRGTG is a wage growth adjustment variable incorporated to allow the influence of government wage policies.

Prices

In discussing the determination of the various price deflators in the model it is useful to separate them into groups: commodity prices, domestic demand deflators, export deflators, and import deflators. The latter set of deflators is determined under a price-taker assumption. Import deflators are thus solely a function of external prices and the exchange rate. In the case of exports, a price-taker assumption is adopted for some categories, while a price-maker assumption is used for others. To determine the latter prices and domestic demand prices, a reduced-form “stage-of-processing” price model is employed.

Commodity Prices

The model includes prices for the major commodities produced in Mongolia or imported into Mongolia. These prices are assumed to be determined on world markets or set through domestic economic policy. They are used to provide estimates of the impact of these prices on industry costs and final demand deflators. These prices refer to:

- Livestock
- Other agriculture, forestry and hunting
- Crude oil
- Coal
- Gold
- Copper

All of these prices are modelled as a function of a similar price measured in $US. For example, oil prices in Mongolia, PWOIL, are determined as follows:

```
DLOG(PWOIL) = RPWOIL$US/100+ DLOG(EXRTGUS)
```

where RPWOIL$US is world oil price inflation measured in US dollars.

The gross output deflators, for the first two categories above are driven by world prices. The equations for these variables are:

dlog(pgolv) = dlog(pwagrm)+zpgolv

dlog(pgooagfh) = dlog(pwagrm)+zpgooagfh

where pgolv is the gross otuput deflator for livestock, pgooagfh is the gross output deflator for other agriculture, forestry and hunting, pwagrm is the world price for agriculture raw materials measured in Mongolian currency and zpgolv and zpgooagfh are price growth adjustment variables.

The gross output deflator for the coal industry, pgocoal, is assumed to be determined through economic policy. A simulation rule of the following form is employed:

dlog(pgocoal) = dlog(pc) + zpgocoal

where zpgocoal is a price growth adjustment variable. In this equation coal prices grow at the same rate as consumer prices. The adjustment variable can be used to change this relationship.

The price equations for gold and copper are discussed below under the description of export prices.

Industry Costs

Industry costs are represented by cost indices in the model. The cost indices are derived using a reduced-form stage-of-processing approach. The approach is a reduced-form one in that commodity prices determined on world markets or prices determined outside the general domestic price determination process become the determinants of domestic costs.

To illustrate this approach it is useful to partition the input share matrix associated with the economy's input-output table. The input share matrix is derived from the economy's input matrix, which is shown below.

Outputs

Inputs

	World	Domestic
World	WW	WD
Domestic	DW	DD
Value Added	VAW	VAD

The industries in the table have been separated into those whose product prices are determined on world markets (W) and those whose prices are determined in domestic markets (D).

The sub-matrix WW represents the outputs of industries whose prices are determined on world markets that are used as inputs by these industries. DD is the sub-matrix that represents the inputs of products whose prices are determined in domestic markets that are used by these industries. WD represents the products of world price determined industries used as inputs by industries whose prices are determined on domestic markets. VAW and VAD are the value added rows in the input matrix.

To model the costs for domestic industries the right partition of the input matrix is employed – WD, DD, and VAD.

The cost of production for an industry is the costs of its inputs. The unit cost of production – total costs divided by gross output – is a input-share weighted average of the unit costs of the inputs.

For the industries whose prices are determined domestically the cost determination can be written as:

```
Cd = W*Pw + D*(I-M)*Cd + D*M*Pim+VD*Cvad
```

where W is the WD share matrix transposed, D is the DD share matrix transposed, M is a diagonal matrix containing the import shares of products in the D matrix, Cd is a vector of domestic costs, Pim is a vector of import prices for the products covered in the D matrix, VD is the VAD matrix transposed, and Cvad is a vector of value added prices.

In the above equation, a distinction is made between products produced by domestic industries and imports of these products. The prices of the products may differ because they are imperfect substitutes.

The cost equations for the industries are obtained by solving the above equation for Cd:

```
Cd = INV(I-D*(I-M))*(W*Pw+D*M*Pim+VD*Cvad)
```

where INV is the inverse operator.

In this equation, domestically determined industry prices are a linear function of the industry prices determined outside Mongolia or exogenous to the current price-determination process, import prices, and the domestic value-added prices.

In the model it is assumed that the only import prices are those for the import categories included in the model and that the economy wide value-added price is representative of the individual value-added prices. The latter variable is represented by a Cobb-Douglas cost function to be described below.

The industry cost equations are coded in change-in-log form where the coefficients in the equations are normalized to unity. In addition to the commodity prices described above, the electric power and heating gross output deflator, PGOEH, is included in the reduced-form.

An example of an industry cost function is that for the manufacturing industry, CIMA:

```
dlog(cima)=0.1618*dlog(pgolv)+0.1553*dlog(pgooa
gfh)+0.0051*dlog(pgocoal)+0.0236*dlog(pwoil*(1+
trcimd))+0.0363*dlog(pgoeh)+0.0564*dlog(pwman*(
1+trcimd))+0.0126*dlog(pims)+0.5490*cqe.
```

The pwman price represents the price of imports of manufactured goods. Both this price and pwoil is adjusted for customs duties through the rate trcimd. The variable cqe represents value-added cost inflation.

The coefficients in the equation indicate the impact of changes in the respective price on industry costs. For example, a 10 per cent increase in petroleum prices – as represented through world oil prices – leads to a 0.236=10*.0236 per cent increase in manufacturing costs. The large coefficients on agriculture prices in the equation result from the fact that food processing and textile and clothing production make a large part of manufacturing activity and use agricultural products as inputs.

The equations for the other industries in the model have an identical structure with the exception of that the coefficients take on different values.

The equations for education, health and social and government services do not contain the value-added component since they are used to estimate the government non-wage expenditure deflator.

The gross output deflator for electric power and heating is computed using the information in the input matrix for all goods and services:

```
dlog(pgoeh)=0.2198*dlog(pgocoal)+0.0067*dlog(ci
omi)+0.05302*dlog(cima)+0.1736*dlog(pwoil*(1+tr
cimd))+0.0323*dlog(ciou)+0.04638*dlog(citsc)+0.
0063*dlog(cifi)+0.212*dlog(pwman*(1+trcimd))+0.
0134*dlog(pims)+0.2361*cqe+zpgoeh
```

where zpgoeh is an inflation adjustment variable.

Domestic Demand Deflators

The equations for the domestic demand deflators are derived using the final demand matrix of the input-output table. The equations are functions of world determined prices, industry costs, import prices, and indirect tax rates.

Each column of the final demand matrix shows how the total value of a demand category is distributed across the products that make up the category. The unit price for the category is a weighted average of the prices of the products that make up the category along with indirect taxes less subsidies. The weights are the shares of the products in the the category.

The final demand share matrix can be partitioned into those products whose prices are determined on world markets and products whose prices are determined domestically. The latter products can then be split between domestically produced products and imported products.

	Final Demand Categories
World Price Determined	WFD
Domestic Price Determined	DFD
Indirect Taxes Less Subsidies	TS

The prices for the final demand categories can be expressed as:

```
Pf = HW*Pw + HD*(I-M)*Pd+HD*M*Pim+ts
```

where HW is a matrix containing the transposed portion of the final demand share matrix containing the shares for world determined – WFD – HD is the transposed portion of the final demand share matrix for domestically determined – DFD – M is a diagonal matrix containing import shares for products in the HD matrix, Pd is domestic industry prices, Pim is import prices, and ts is a vector of indirect taxes less subsidies.

Assuming the indirect taxes less subsidies are proportional to the prices of the products on the right-hand-side of the equation, the final demand prices can be expressed as:

```
Pf*INV(I+TS) = HW*Pw + HD*(I-M)*Pd+HD*M*Pim
```

wher TS is a diagonal matrix of indirect taxes less subsidy rates.

Similar to the industry cost equations, the coefficients of the prices on the right-hand-side of the equation are normalized to unity and the equations are specified in change-in-log form.

An example of this type of equation is that for the price deflator for consumer expenditures for food, beverages and tobacco:

```
dlog(pcfbt/(1+tricfbt))                                    =
0.4160*dlog(pgolv)+0.0934*dlog(pgooagfh)
+0.1562*dlog(cima)+0.0800*dlog(citr)+0.2344*dlo
g(pwman*(1+trcimd))+0.0200*dlog(pims)+zpcfbt
```

where zpcfbt is a price growth adjustment variable.

The equations for the other categories are identical to this equation with the exception of the values of the coefficients and indirect tax variables employed.

Unit Cost Function

The cost function adopted for the model is consistent with the model's production technology and is thus a Cobb-Douglas cost function. The short-run marginal cost, CQ, coded in change in log form is:

```
DLOG(CQ)=      DLOG(WRPTG)+(1-LS)/LS*(DLOG(YGDP)-
DLOG(K[-1]))- ZTFP
```

where LS is labour's share in nominal GDP, K is capital stock, and ZTFP is the rate of total factor productivity growth.

In this case, marginal costs grow at a rate specified by the wage rate, total factor productivity, and the output-capital ratio. If output rises relative to the stock of capital - capacity utilization rate rises - short-run marginal costs rise.

Export Price Deflators

Export prices are determined in a manner similar to domestic demand deflators or set on world markets. In the former case they are a function of industry costs. In the latter case they growth like comparable world prices.

The equation for the price deflator for exports of other agriculture, forestry and hunting exports illustrates the world determined approach:

```
dlog(pxgoagfh) = dlog(pwagrm) + zpxgoagfh
```

where zpxgoagfh is a growth adjustment variable.

The export price equation for manufactured products is driven by domestic costs:

```
dlog(pxgma) = dlog(cima) + zpxgma
```

where zpxgma is a growth adjustment variable.

Import Price Deflators

The import price equations are generally derived under the assumption that Mongolians are price takers. In this case, the equations for import prices are of the general form:

```
DLOG(PIM(I)) = DLOG(PF*EXRTGUS)
```

where PIM is the import price and PF is the foreign price.

The above equation simply assumes that import prices grow at the same rate as similar foreign prices measured in Mongolian currency.

The equation for manufactured product imports, pimgma, is an example of this type of equation:

```
dlog(pimgma)                                    =
simgmapp*dlog(pwoil)+simgmafb*dlog(pwfood)+(1-
simgmapp-simgmafb)*dlog(pwman)+ zpimgma
```

where simgmapp is the share of petroleum products in manufactured imports, simgmafb is the share of food products in manufactured imports, and zpimgma is a growth adjustment variable. In this equation manufactured imports are a weighted average of the prices of the key imported products.

Income

The income sector of the model is concerned with the determination of nominal Gross Domestic Product, the components of net domestic income, personal income, and corporate income.

The domestic income components are modelled in current Tg with other net domestic income serving as the category that ensures the equality between income and expenditures in the model.

The equations for many of the components for personal and corporate income are identities as these categories are largely determined from variables from other sectors of the model.

Gross Domestic Product

Gross Domestic Product at market prices, YGDPTG, is defined in the model as the sum of the components of Gross Domestic Expenditures:

```
ygdptg=ctg+gcgstg+gitg+irbtg+inrbtg+igcfotg+xtg
-imtg+vctg+gderestg.
```

Domestic Income

In the National Income and Expenditure Accounts, Gross Domestic Product and Gross Domestic Expenditures are always equal. To ensure this equality in the model, the income side is treated as the residual.

Net Domestic Income

Net dometic income measured at factor cost, YNDTG, is determined from the identity:

```
yndtg=ygdptg-tistg-ccatg
```

where ccatg is the capital consumption allowance and tistg is indirect taxes less subsidies.

Capital Consumption Allowances

Capital consumption allowances are computed using a depreciation rate, rdk, multiplied by the replacement value of the capital stock

```
ccatg=rdk*pinrb*k[-1].
```

Labour Income

This variable is determined from an identity incorporating wage rates and employment:

```
yltg=wrptg*(e-egov-eafh)+pgcgsw*gcgsw
```

where the first term applies to private income and the second to government income. Employment in agriculture, forestry and hunting is excluded from this calculation under the assumption that almost all of the employees in this sector are self employed.

Net income of Unincorporated Business

This income, YUBTG, is modelled as a function of income in the nominal GDP in selected industries in the economy:

```
dlog(yubtg)=         dlog(pgolv*ygdplv+pgooagfh*
ygdpoagfh     +citr*0.3*ygdptr+cifi*0.05*ygdpfi+
citsc*0.3*ygdptsc+cios*0.55*ygdpos)+zyubtg
```

where zyubtg is a growth adjustment variable. The coefficients reflect the share of unincorporated business in the industries.

Other Net Domestic Income

This variable is the one that is used to ensure the equality between income and expenditures. It is determined from the identity:

```
yndotg=yndtg-yltg-yubtg.
```

This category of income is a measure of the income associated with the activity of corporations.

Personal Income

Personal Income

Such income is determined from the identity:

yptg=yltg+yubtg+yoptg+gtptg

where yoptg is other personal income and gtptg is government transfers to persons.

Other Personal Income

This income is assumed to grow like a moving average of other net domestic income:

dlog(yoptg) = mavg(2:dlog(yndotg))+zyoptg

where zyoptg is a growth adjustment variable. This equation assumes that the source of income is corporations either in the form of dividend payments or corporate transfers to persons.

Personal Disposable Income

This variable is defined as:

ypdtg=yptg-ttyptg-tsiptg

where ttyptg is personal income taxes and tsiptg is personal contributions to government social insurance plans.

Government

This sector of the model refers to total – general – government revenues and expenditures. Almost all of the equations used to model revenues and expenditures are simulation rules or identities. In some cases these equations include statutory tax rates. For the remainder, exogenous growth rates, synthetic tax rates and bases are employed.

The data in this sector refer to the public accounts. There is also government data in the model that are measured on a National Income and Expenditure Accounts (NIEA) basis. The latter data are largely expenditure variables. It is assumed in the model that the NIEA data determines the performance of public accounts variables.

Revenues

Total Revenues and Grants

These revenues, TRGTG, are computed through the following indentity:

```
trgtg=trtg+tcaptg+tgtg
```

where TRTG is current revenues, TCAPTG is capital revenues and TGTG is grants. Current revenues are determined in the model while capital revenues and grants are exogenous variables.

Current revenues are computed as:

```
trtg=ttrtg+tnttg
```

where TTRTG is tax revenues and TNTTG is non-tax revenues.

Taxes

Total tax revenue is computed through the identity:

```
ttrtg=ttytg+tsitg+tpttg+titg+tcdtg+totg
```

where TTYTG is income tax, TSITG is social insurance revenues, TPTTG is property tax revenues, TITG is taxes on goods and services, TCDTG is customs duties and TOTG is other taxes.

Income Tax

Income tax is separated into personal, TTYPTG, and corporate, TTYCTG, tax:

```
ttytg=ttyptg+ttyctg.
```

Personal income taxes are modelled as the product of personal income, YPTG, and an effective tax rate, RTTYPTG:

```
ttyptg=rttyptg*yptg.
```

Corporate income taxes are computed as a product of tax rates and a tax base that includes other net domestic income:

```
ttyctg=rttyctg*(trycl+rtrych*trych)*yndotg
```

where TRYCL is the low corporate tax rate, TRYCH is the high corporate tax rate, RTRYCH is the proportion of the tax base subject to the high rate, and RTTYCTG is a tax base adjustment factor – the tax base is RTTYCTG*YNDOTG.

Social Insurance Contributions

These contributions are separated in those to the Social Insurance Fund, TSISIFTG, and the Health Insurance Fund, TSIHIFTG:

```
tsitg=tsisiftg+tsihiftg
```

Revenues from the social insurance fund are computed as the product of an effective constribution rate and labour income excluding social insurance contributions:

```
tsisiftg=rtsisftg*yltg/(1+(1-
rtsipsiftg)*rtsisftg +(1-rtsiphiftg)*rtsihftg)
```

where RTSISFTG is the effective social insurance fund contribution rate, RTSIHFTG, is the effective health insurance fund contribution rate, RTSIPSIFTG is the share of personal contributions to the social insurance fund and RTSIPHIFTG is the share of contributions to the health insurance fund. Dividing labour income by the factor (1+(1-rtsipsiftg)*rtsisftg +(1-rtsiphiftg)*rtsihftg) removes social insurance contributions contained in YLTG.

Personal contributions, TSIPSIFTG, are computed as a share of total contributions.

```
tsipsiftg=rtsipsiftg*tsisiftg
```

Health insurance fund contributions are computed in an identical manner to those for the social insurance fund:

```
tsihiftg=rtsihftg/(1+(1-rtsipsiftg)*rtsisftg
+(1-rtsiphiftg)*rtsihftg)*yltg
```

Personal constributions are a share of total contributions:

```
tsiphiftg=rtsiphiftg*tsihiftg.
```

Property Taxes

These taxes are applied to residential and non-residential structures. They are assumed to grow at the same rate as the value of the stock of these structures:

```
dlog(tpttg)=wtr*dlog(pc*kh[-1])+(1-
wtr)*dlog(pinrb*k[-1])+ztpttg
```

where wtr is a weight reflecting the proportion of taxes collected from residential sources and ztpttg is a growth rate adjustment factor.

Taxes on Goods and Services

These taxes, TITG, are comprised of VAT, TIVATTG, excise taxes on alcohol and beer, TIEABTG, and other excise taxes, TIOTG:

```
titg=tivattg+tieabtg+tiotg
```

VAT revenues are computed as the product of the VAT rate, TRVAT, and a tax base:

```
tivattg=trvat/(1+trvat)*rtrvat*ydatg
```

where rtrvat*ydatg is the tax base. YDATG is domestic absorption and RTRVAT is a tax base adjustment factor. The tax base is divided by (1+TRVAT) to remove VAT from YDATG.

Alcohol and beer excise taxes are assumed to grow at the same rate as consumer expenditures on food, beverages, and tobacco:

```
dlog(tieabtg)=dlog(cfbttg)+ztieabtg
```

where ztieabtg is an adjustment factor.

Other excise taxes are applied largely to imports of manufactured goods and are assumed to grow at the same rate:

```
dlog(tiotg)=dlog(imgmatg)+ztiotg
```

where ztiotg is a growth adjustment factor.

Customs Duties

These taxes are separated into those for imports, TCDIMTG, and for exports, TCDXTG:

tcdtg=tcdimtg+tcdxtg;

Customs duties for imports are computed as a product of the tax rate, RTCIMD, and a tax base represented by goods imports:

```
tcdimtg=trcimd*rtcdimtg*imgtg,
```

where RTCDIMTG is a tax base adjustment factor and IMGTG is nominal goods imports.

Customs export duties are assumed to be applied to a proportion of exports of livestock

```
tcdxtg=rtcdxtg*xglv,
```

where RTCDXTG is an effective tax rate.

Other Taxes

These taxes apply largely to the forestry, mining, and transportation, storage, and communications industries. They are assumed to grow at the same rate as real GDP in these industries plus overall GDP inflation:

```
dlog(totg)=dlog(pgdpfc)+dlog(ygdpoagfh+ygdpmi+y
gdptsc)+ztotg
```

where ztotg is a growth adjustment variable.

Non-Tax Income

This income is assumed to grow at the same rate as nominal GDP:

```
dlog(tnttg)=dlog(pgdpfc*ygdp)+ztnttg
```

where ztnttg is a growth adjustment factor.

Expenditures

Current Expenditures

Current expenditures, GCETG, are determined as the sum of goods and services expenditures, GCGSGTG, interest on debt, GIPDTG, subsidies, GSUBTG, and transfer payments, GTRTG:

```
gcetg=gcgsgtg+gipdtg+gsubtg+gtrtg;
```

Goods and services expenditures on a public accounts basis are separated into those for wages, GCGSWGTG, and other goods and services, GCGSOGTG:

```
gcgsgtg=gcgswgtg+gcgsogtg.
```

These expenditures are also separated on a NIEA basis into those for health and social services, GCGSHS, education services, GCGSES, and government services, GCGSGS:

```
gcgs=gcgshs+gcgses+gcgsgs
```

Wage expenditures, measured on a public accounts basis, are assumed to grow like those on an NIEA, GCGSWTG:

```
dlog(gcgswgtg)=dlog(gcgswtg)+zgcgswgtg
```

where zgcgswgtg is a growth adjustment variable.

The NIEA expenditures are determined as a product of real wage expenditures, GCGSW, and the government wage deflator, PGCGSW:

```
gcgswtg=pgcgsw*gcgsw
```

Real wage expenditures on an NIEA basis grow at the same rate as employment in the education, health and social, and government sevices sectors:

```
dlog(gcgsw)=dlog(ehs+ees+egs)+zgcgsw
```

where zgcgsw is a growth adjustment variable.

Other goods and services expenditures on a public accounts basis are assumed to growth like their NIEA counterpart:

```
dlog(gcgsogtg)=dlog(gcgsotg)+zgcgsogtg
```

where zgcgsogtg is a growth adjustment variable.

The NIEA real other expenditures are determined as a residual from total expenditures and wage expenditures:

```
gcgso=gcgs-gcgsw.
```

Nominal expenditures are determined as the product of the real expenditures and the price deflator for other expenditures, PGCGSO:

```
gcgsotg=pgcgso*gcgso
```

Subsidies

Government subsidies are modelled on a real per capita basis with an exogenou s growth rate, RGSUBTG, determining rising or falling real per capita values:

```
gsubtg=gsubtg[-1]*pc*dp*(1+rgsubtg/100)/(pc[-
1]*dp[-1]).
```

Transfer Payments

Transfer payments are those for non-profit institutions, GTRNPITG, persons, GTPTG, foreigners, GTFTG, and other transfers, GTOTG:

```
gtrtg=gtrnpitg+gtptg+gtftg+gtotg.
```

Transfers to persons are modelled on a real per capita basis with an exogenous growth rate, RGTPTG:

```
gtptg=gtptg[-1]*pc*dp*(1+rgtptg/100)/(pc[-
1]*dp[-1])
```

Foreign transfer payments are modelled in real terms using an exogenous growth rate, RGTFTG:

```
gtftg=gtftg[-1]*pc*(1+rgtftg/100)/pc[-1]
```

Other transfer payments are exogenous.

```
gcbaltg=trtg-gcetg;
```

Capital Expenditures and Net Lending

Capital expenditures on a public accounts basis, GIGTG, are assumed to growth at the same rate as their NIEA counterpart:

```
dlog(gigtg)=dlog(gitg)+zgigtg
```

where zgigtg is a growth adjustment variable.

Real capital expenditures on a NIEA basis growt like investment in education, health and social, and government services:

```
dlog(gi)=dlog(ies+ihs+igs))
```

Nominal expenditures are determined as the product of real expenditures and the government investment price deflator, PGI:

```
gitg=pgi*gi
```

Net lending is modelled on a real per capita basis using an exogenous growth rate, RGNLTG:

```
gnltg=gnltg[-1]*pc*dp*(1+rgnltg/100)/(pc[-
1]*dp[-1]
```

Government Balances

The current balance is defined as:

gcbaltg=trtg-gcetg

The overall government balance is computed as:

gobaltg=gcbaltg+tcaptg+tgtg-gigtg-gnltg

Financial Markets

At present there is only one equation for the financial sector of the model. This equation is for the exchange rate.

A simulation rule is used for the exchange rate that adjusts the rate in response to the size of the current account balance as a percent of GDP:

DLOG(EXRTGUS) = -MAVG(3: BPCATG/YGDPTG) + ZEXRTGUS

where EXRTGUS is the Tg/US exchange rate, BPCATG is the current account balance, YGDPTG is nominal GDP and ZEXRTGUS is a growth rate adjustment factor.

If the user wishes to take into account capital flows that offset the impact of current account changes on the exchange rate, such an adjustment can be made with ZEXRTGUS.

Model Files

The computer files needed to use the model are ES Tools files and data and model spreadsheets. The data and model spreadsheets are Excel spreadsheets. The files can be separated into those that define the model, macros and data spreadsheets employed to update the model data base, the model spreadsheet that runs the model, and tables used to view and export simulation results. It is assumed below that the reader is familiar with the type of files used in ES Tools and Excel spreadsheets.

Data Base Update Files

There is a number of files required to update the model's data base. At present almost all of the data are stored in data spreadsheets. Macros are then used to create additional data and data transformations from these basic data. In some cases basic data are stored in macros.

Data Bases

The main ES Tools data base for the model is named MMM### where ### refers to the date of the data base update. Ultimately all model data must be put into this base.

Other data bases are employed to update the model's data base. These hold temporary data. ES Tools macros then either copy these data directly into the model base or transform the data and put them into the model base.

In addition to the model base, forecast bases are created that contain the results of the forecasts or policy simulations created with the model. The forecast base is presently named MMMF### where ### refers to the date of the forecast. The latter naming normally is the same as the model's historical base MMM###. Model users can employ their desired naming schemes.

Data Spreadsheets

These spreadsheets contain much of the basic data used for the model. The file names for data spreadsheets all start with "dss."

DSSGDE – contains the nominal components of Gross Domestic Expenditures from NSO. This spreadsheet is run into the ES Tools base otherdata.

DSSGO – contains nominal and real gross output data by detailed goods-producing categories from NSO. This data spreadsheet is run into the ES Tools base inddata.

DSSGDP – contains nominal and real GDP data by industry from NSO. This spreadsheet is run into inddata.

DSSEMPIND – contains employment by industry from NSO. This spreadsheet is run into the ES Tools base inddata.

DSSTRADE – contains nominal goods imports and exports by major category from NSO. This spreadsheet is run into the ES Tools base tradedata.

DSSMISCDATA – contains miscellaneous data from NSO and other sources. This spreadsheet is run into the ES Tools model base.

DSSBOP – contains the balance of payments data from the BMO. This spreadsheet is run into the ES Tools base tradedata.

DSSGOV – contains the government data from the Ministry of Finance. This spreadsheet is run into the ES Tools base otherdata.

Update Macros

A number of macros is used to create the model's historical data base. These macros need to be run in a specific order, since the creation of some data requires the previous creation of other data. The macro names suggest the order in which they are to be run.

The macros contain documentation to assist the user to understand what is being done in the macro. If users change the macros, they should change the documentation.

UP1IND

This macro creates the data associated with the various industries in the model.

UP2BASIC

This macro copies basic data from the various data bases into the model data base in preparation for the running of the remaining macros.

U3GOV

The government data are copied into the model base from the base otherdata.

U4TRADE

This macro creates the trade data for the model. Nominal, real, and price deflators for imports and exports are created and copied into the model base.

UP5CY

The consumer expenditure and personal income data are created in this macro along with consumer expenditure deflators.

UP6GDE

This macro creates the nominal, real, and price deflators for the various categories of Gross Domestic Expenditures.

UP7ZVARS

The growth adjustments and other dummy variables and time trends are created in this macro.

UP8MISC

This macro creates the final set of data in the model that need the data created to this point to perform transformations.

DEFVAR

The definitions and sources for the model's variables are created in this macro. The macro needs to be run into the forecast base and then read into the model spreadsheet along with the model data.

Model Operation Files

There is a number of files associated with the model. If you plan to change the model you will need to understand what they are and what they do. Otherwise, only the model spreadsheet is importants.

ES Tools Model Files

The files associated with the model are as follows:

mmm##.eqn – the ES Tools equation file that contains the model code

mmm##.mdl – ES Tools compiled code for the model

mmm##.opt – the ES Tools model option file

In addition to the above files, ES Tools variable list ".lst" files are employed to exclude variables when producing forecasts. The contents of these files change depending on the the variable exclusions set by model users.

Model Spreadsheet

The model spreadsheet for the MMM is included in an Excel spreadsheet named MSSMMM###. The ### refers to the vintage of the spreadsheet.

Tables

The model comes with a number of ES Tools tables that can be used to view historical and forecast data. Model users can create their own tables or link spreadsheets to the model spreadsheet containing the model data.

The ES Tools tables include:

KEY – key indicators

GDE – gross domestic expenditures

GDPIND – real GDP by industry

EMPIND – employment by industry

INVESTIND – investment by industry

KIND – capital stock by industry

EXPORTS – exports by industry

IMPORTS – imports by industry

PRODIND – labour productivity by industry

GOV – government revenues and expenditures

CE – consumer expenditures

YNN – domestic and personal income

SHKTAB – a shock minus control table for key indicators

SHKGDE – a shock minus control table for GDE components

SHKGDP – a shock minus control table for GDP by industry

MMM Model Spreadsheet

The MMM model spreadsheet is an Excel spreadsheet that is used by ES Tools's spreadsheet control to create forecasts and conduct impact studies.

Spreadsheet Format

There are four sections in the spreadsheet. The first section contains information about the model and files associated with using it. The second section contains the exogenous variables. The third section contains the stochastic variables, corresponding add factors, and exclude switches. The exclude switches allow you to impose your own forecasts rather than those produced by the model's equations. The fourth section contains the values of the variables that have identities for equations.

First Section

The following information is contained in the first section of the spreadsheet:

- Model: the name of the model – normally the name mmm## where ## specifies the vintage of the model. For example, mmm031 would refer to the model used to produce the first forecast in 2003.
- Model Frequency: the frequency of the model – the model is annual so the frequency is set to 1.
- History Base: the name of the ES Tools base that contains the history for the model – the name of this base is normally the same as the model – mmm031.
- Forecast Base: the name of the ES Tools base where the forecast data are to be stored – the name normally given for this base is mmmf## where ## specifies the vintage, for example, mmmf031 would be used for mmm031.
- Shock Extension: the shock extension for the forecast variables if any – this option is normally used when the model user is conducting an impact study and wishes to give the variables a different name from those in the base case forecast.

- Spreadsheet Range: the range of the data included in the spreadsheet – unless you wish to increase the amount of history in your spreadsheet you would not change this range.
- Model Solution Range: the date range for which the forecast is to be conducted – you can change this range, but normally only the end date for the forecast – for example, if the range is set at 2002-2012, you could change it to 2002-2005, you can't change 2002 to 2002;
- Batch File (optional): the name of the batch file that is to be used to run the model – this option is for advanced users of ES Tools;
- Table(optional): the name of the Excel spreadsheet to create after running the model – you should not change this name unless you are an advanced user of ES Tools; and
- Table Range: the date range for the table – if you are linking forecast spreadsheets to the one created through the Table option, then will need to set this range accordingly.

Second Section

The assumptions for the exogenous variables in the model are included in this section. Each row contains the variable name in the first column, an optional description of the variable in the second column and the values of the variable in the remaining columns.

Third Section

This section contains the stochastic variables in the model, the associated add factors, and switches that allow the user to exclude the variables at the value specified in the spreadsheet.

The first row for each stochastic variable includes the variable name in the first column, the description of the variable in the second column, and the data for the variable starting in the third column.

The second row for the stochastic variable starts with "Exclude," which tells ES Tools that this row is the exclude switch row for the variable shown in the second column – do not erase this name or ES Tools will not be able to exclude the variable. Starting in the third column are the on (=1) and off (=0) values for the exclude switch. Putting a 1 for a specific date or multiple dates in the cells in this row causes ES Tools to exclude these variables from the model solution.

The third row contains the add factor for the variable. The first column provides the name for the add factor, the second column an optional description of the add factor, and the remaining columns in the row contain the values of the add factors for the dates in the model solution range.

Fourth Section

The values of the identities are included in this section. They are not required to run the model. They are included to allow model users to link their forecast table spreadsheets to the model solution.

Comments: Work Areas

You can create working rows in the spreadsheet by putting "COMMENT" in the first column of a row. In this case ES Tools ignores what is in the row. As a result, the user can use the row to make calculations needed to specify the values of stochastic variables, add-factors, and exogenous variables.

A COMMENT can go anywhere in the spreadsheet after the first section of the spreadsheet.

Important! If you are using formulas to create assumptions for stochastic variables, add factors or exogenous variables, these formulas should not be stored in the rows for these variables if the user wishes to use the "Update Sheet" option described below after running the model. ES Tools overwrites the cell values when this option is employed – see below for a further discussion of the options regarding the use of formulas.

Spreadsheet Model Menu

The spreadsheet can be edited using Excel or ES Tools's spreadsheet control. For major spreadsheet editing, it is preferable to use Excel, since Excel has much better editing facilities than does ES Tools' spreadsheet. Nevertheless, you must use the ES Tools spreadsheet control to run the model. In addition, there are a couple of options that are available in ES Tools that are not found in Excel that are useful for excluding variables.

To use the spreadsheet model menu, you must start up ES Tools spreadsheet control and then open up the model spreadsheet. You can then view the items in the Model menu.

View Model

The View Model item puts you in the ES Tools editor to view the model's equations. If you are adjusting equation values it is important to understand how the equations work. The equations are presented in a format that shows their structure and coefficient values.

Model Block Structure

Model Block Structure puts you in the editor to view the block structure of the model.

Model Description

Model Description starts up the viewer that contains a documented description of the model, as well as the information you are currently reading.

Update Model Files

You must select this item before you can run the model. The item updates ES Tools bases and creates lists and macros needed to run the model based on the information contained in the spreadsheet.

Run Model

This item runs the model. If the user has chosen to use an ES Tools Batch file, then this file is run. Otherwise ES Tools runs the model using the macro created from spreadsheet information.

Update Stochastic

The values of the stochastic variables in your spreadsheet can be updated after running the model using this item. The values for the update are obtained from the forecast base specified in the spreadsheet. As mentioned above, if you are using formulas to create assumptions for excluded stochastic variables, they will be overwritten by ES Tools if this option is employed.

Important! This item will not overwrite formulas for add-factors and exogenous variables, since it does not update these variables. It is not necessary to update the latter variables in any case, since they are the same as those contained in the spreadsheet. As a result, you can use formulas for add-factors and exogenous variables.

Update Sheet

This item will update all of the variables in your spreadsheet from the forecast base. As mentioned above, you should not use this item if you are using formulas for add-factors and exogenous variables. Normally this option is only used when updating the spreadsheet to include new historical data.

Exclude All and Exclude None

The Exclude All item can be used to exclude all stochastic variables contained in your spreadsheet for a particular date. To indicate which date is selected, click your mouse on the desired column. The date selected must be in the model solution range. You can only exclude one date at a time using this option.

The Exclude None option will remove any existing 1's from the spreadsheet for the stochastic variables switches for the entire model solution range and set the cells to 0.

Steps for Using a Model Spreadsheet

The sequence of steps employed in using the model spreadsheet are generally as follows.

1. The user would start up ES Tools and invoke the spreadsheet control by choosing the Spreadsheet item from the Tools menu;

2. The model spreadsheet would then be opened using the Open item from the File menu and choosing the desired spreadsheet;
3. The user would specify the assumptions for the add-factors, excluded variables, and exogenous variables – as mentioned above, this step can also be conducted using Excel;
4. The model's data base would then be updated and various exclude lists and the model solution macro created by selecting the "Update Model Files" option in the Model menu of the spreadsheet control;
5. The model would be solved by choosing the Run Model option from the Model menu;
6. The results of the simulation of the model could then be viewed using the spreadsheet(s) created for this purpose;
7. The user would then invoke the spreadsheet control and employ the "Update Stochastic" option from the Model menu to update the values of the stochastic variables in the spreadsheet; and
8. The user could then use the spreadsheet control or Excel to make further changes to the model variables as in Step 3.

The above sequence of steps would be conducted until the model user obtains a satisfactory forecast.

Mongolian Macro Model

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Agenda

- Background
- MMM overview
- Impact studies
  - Coal price increase
  - Corporate tax cut
  - Government wage increase
  - New gold mine

MMM Project

- Develop multi-sector macro model
  - Examine future industrial performance
  - Links between government and economy
  - Impact analyses
- Joint venture
  - EPSP
  - Bank of Mongolia, Ministry of Finance, NSO, and the PMO

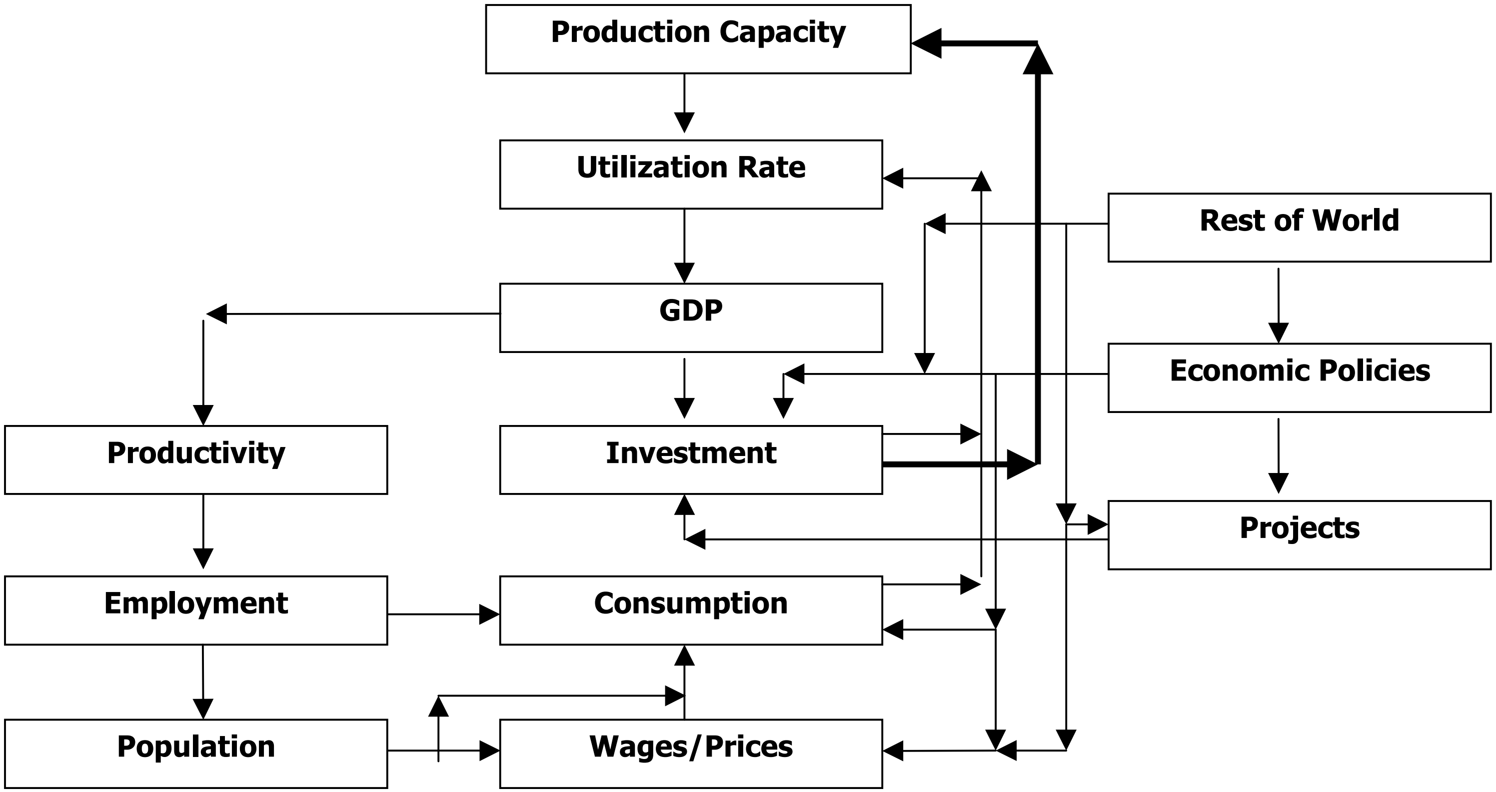
Project Status

- First version of the model complete
- Comprehensive data base built
- Model being tested
- Model training under way
- Data and model improvements being identified

Model Characteristics

- Multi-sector (GE) model
- 15 industries
  - Real GDP, employment, investment, capital stock, costs, prices
- Gross Domestic Expenditures
  - Major components and detail for trade and consumer expenditures
- Government income statement
- Stage of processing price model
  - Commodities, industries, final demand

Workings of the Model



Major Projects

- Model designed to conduct impact studies for major projects
- Input (Direct impact)
  - Project investment, construction employment, operations, employment, and product
- Output (Total impact)
  - Direct plus indirect

Model Calibration

- Data obtained from NSO, BMO and Ministry of Finance
- Missing data were estimated by EPSP
- Modifications were made to convert NSO data to fit model concepts
  - Input/Output table and GDE components
- Parametric model (insufficient historical data for econometric analyses)

Impact Analysis

- Construct a “base” case forecast of the performance of the economy.
- Make a “shock” forecast for the economy with the policy or other changes made.
- Compare the shock and base case forecasts.

Key Assumptions

- Monetary policy is accommodating.
- Capital flows adjust to meet changes in the current account balance.
- No fiscal policy response to the changes.

Coal Price Increase

- Coal price is fixed under international levels
- Scenario raises it 50% in 2004 and maintains that level in real term thereafter.

Coal Price Increase I

% Difference from base case

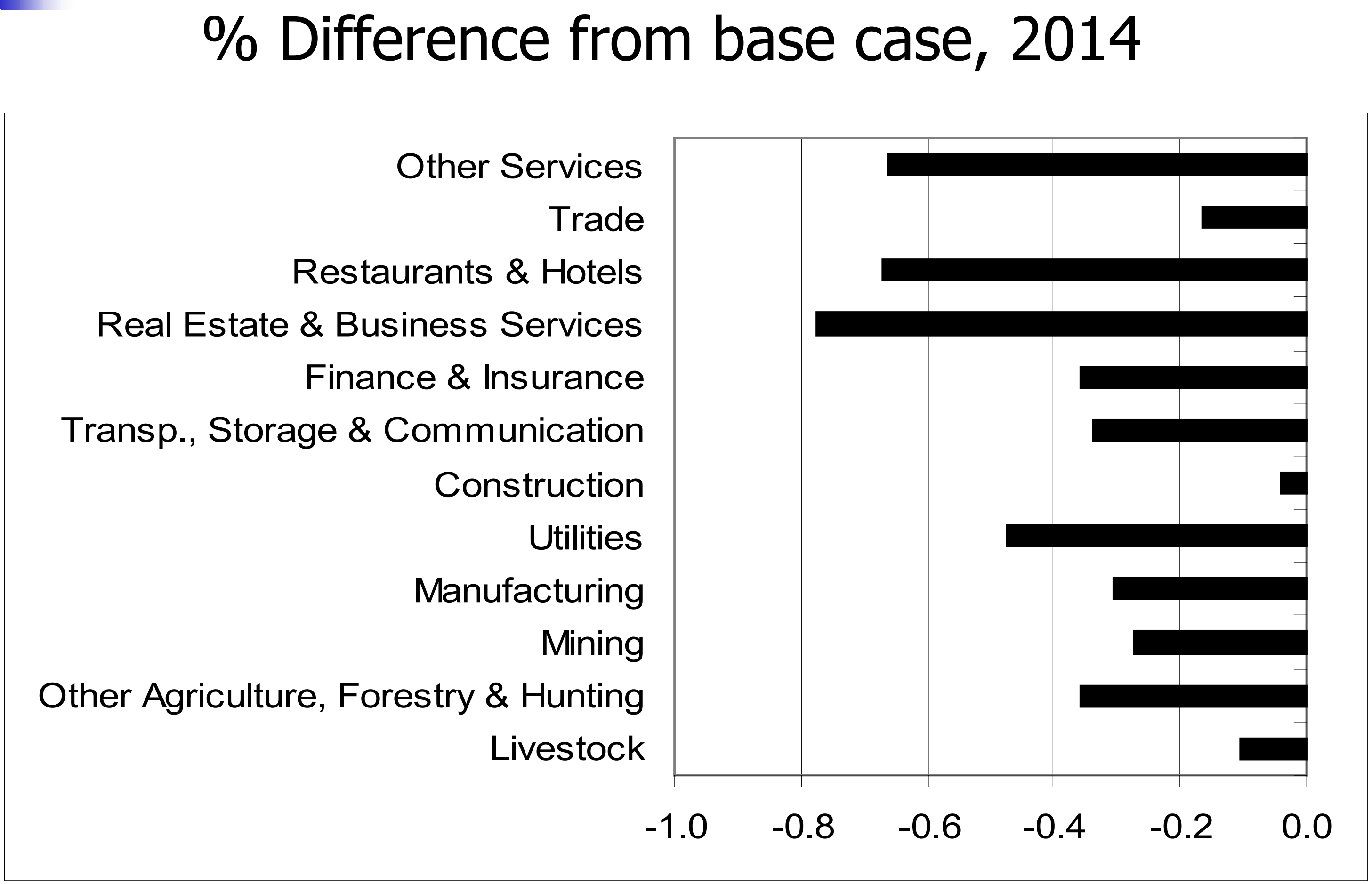
	2004	2008	2014
Real GDP	0.0	-0.4	-0.2
Consumer Price Index	0.7	0.0	-1.3
Annual Private Wage	0.2	-0.2	-1.7
Employment	0.0	-0.4	-0.1
GDP Per Worker	-0.1	0.0	-0.1
Unemployment Rate (Level Difference)	0.0	0.4	0.0
Exchange Rate	-0.1	-0.9	-2.2
Current Account Balance (Tg Billions)	3.6	10.4	24.3
Overall Government Balance (Tg Billions)	-0.1	-5.3	-13.1

Coal Price Increase II

% Difference from base case

	2004	2008	2014
Real GDP	0.0	-0.4	-0.2
Consumer Expenditures	-0.1	-0.3	-0.2
Gross Fixed Capital Formation	0.1	-1.0	0.0
Domestic Absorption	0.0	-0.5	-0.1
Exports	-0.1	-0.5	-0.3
Imports	0.0	-0.3	-0.1
Net Exports (Tg 95 Billions)	-0.1	1.0	0.0

Coal Price Increase III



Corporate Tax Restructuring

- Has been a recent topic of discussion to reduce corporate taxes and create a single rate.
- This scenario lowers the high corporate rate to 25% in 2004 and 15% in 2005.
- Single 15% rate imposed thereafter.

Corporate Tax I

% Difference from base case

	2004	2008	2014
Real GDP	1.2	7.1	5.6
Consumer Price Index	0.6	11.7	13.6
Annual Private Wage	0.6	15.6	19.0
GDP Per Worker	0.2	2.2	5.4
Unemployment Rate %	-0.8	-2.7	1.0
Exchange Rate	0.6	12.8	14.1
Current Account Balance (Tg Billions)	-30.6	-128.5	-109.7
Overall Government Balance (Tg Billions)	-1.2	60.9	37.9

Corporate Tax II

% Difference from base case

	2004	2008	2014
Real GDP	1.2	7.1	5.6
Consumer Expenditures	1.0	6.1	4.4
Gross Fixed Capital Formation	12.2	18.0	12.3
Domestic Absorption	4.1	9.3	6.3
Exports	-0.2	7.2	7.9
Imports	2.6	8.8	7.0
Net Exports (Tg 95 Billions)	-10.2	-36.3	-32.8

Corporate Tax III

% Difference from base case, 2014

Government Wage Increase

- There have been some very large wage increases for government employees over the past few years.
- What sort of impact does this have?
- This scenario raises the wage rate 20% again in 2004.

Government Wage I

% Difference from base case

	2004	2008	2014
Real GDP	1.5	1.6	0.9
Consumer Price Index	0.6	7.8	17.7
Annual Private Wage	0.9	11.5	22.4
Employment	1.6	3.2	1.4
GDP Per Worker	-0.2	-1.5	-0.5
Unemployment Rate %	-1.3	-1.5	0.2
Exchange Rate (Tg/$US)	0.5	7.9	17.7
Current Account Balance (Tg Billions)	-31.4	-105.6	-296.0
Overall Government Balance (Tg Billions)	0.2	-21.7	-22.2

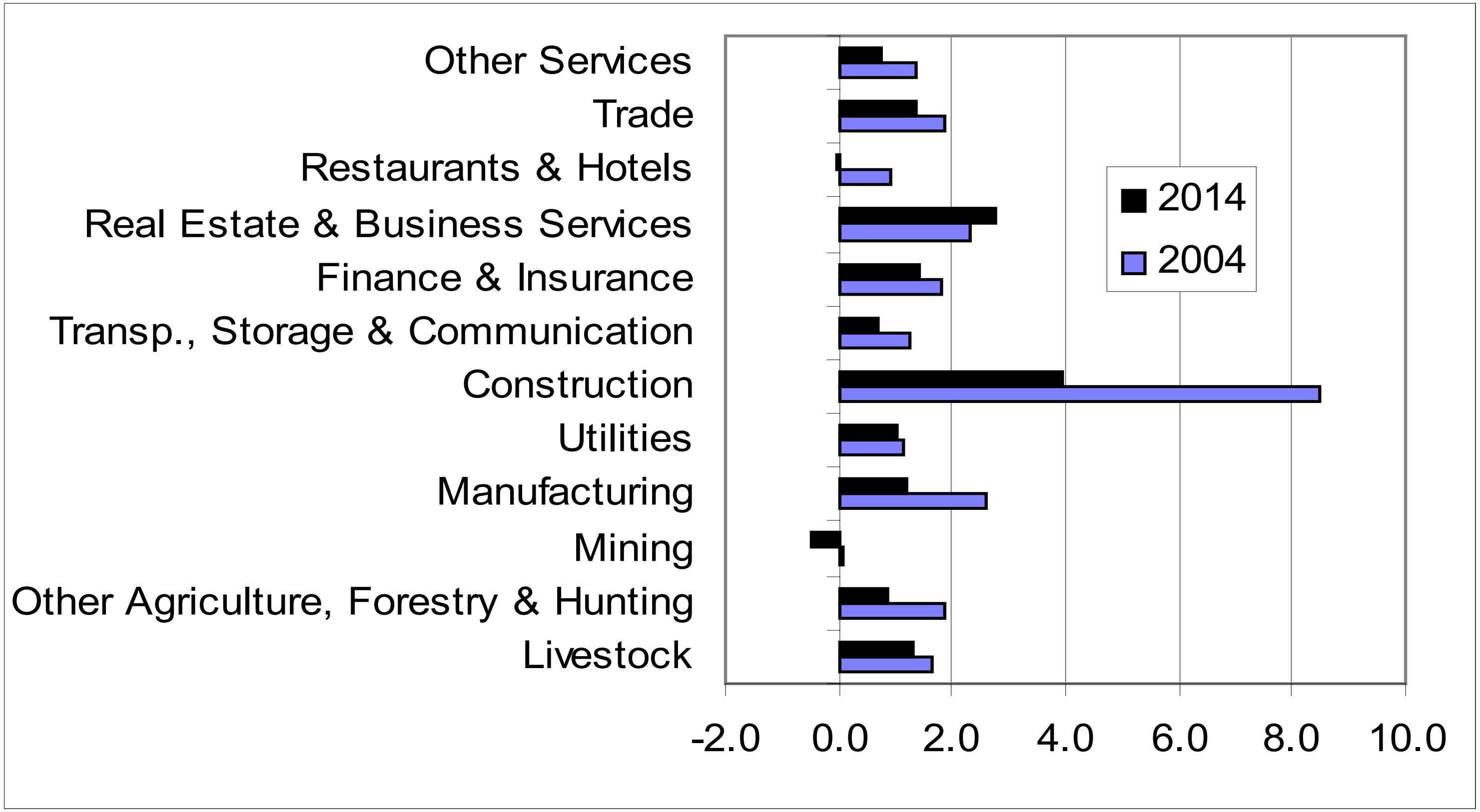
Government Wage II

% Difference from base case

	2004	2008	2014
Real GDP	1.5	1.6	0.9
Consumer Expenditures	3.5	5.2	4.4
Gross Fixed Capital Formation	8.1	4.8	4.5
Domestic Absorption	4.3	4.4	3.9
Exports	-0.4	-0.9	-1.5
Imports	2.7	2.7	2.3
Net Exports (Tg 95 Billions)	-10.5	-13.7	-15.1

Government Wage III

% Difference from base case



Boroo Gold Mine

Capital Value	Tg Billions 50
Construction Jobs	250
Operations Jobs	200
Gold Production	150000 OZ
Gross Output	Tg 95 Billions 27.5
GDP	Tg 95 Billions 24.7
Construction	2002-2003
Production Starts	2004

Boroo Results

	2002	2003	2004	2005	2010	2014
Real GDP	0.6	0.7	7.7	7.9	3.3	2.3
Consumer Price Index	0.2	0.6	1.4	2.5	2.6	0.6
Annual Private Wage	0.2	0.7	2.3	4.6	4.9	1.4
Employment (000s)	0.4	0.7	3.0	3.9	-0.8	-0.4
GDP Per Worker	0.3	0.1	4.5	3.8	4.1	2.7
Unemployment Rate %	-0.3	-0.5	-2.3	-2.8	1.3	0.5
Exchange Rate (Tg/$US)	0.2	0.6	1.1	1.9	1.6	-0.2
Current Account Balance (Tg Billions)	-8.5	-12.8	-27.2	-50.9	-13.0	20.5
Overall Government Balance (Tg Billions)	6.0	8.1	45.6	60.5	53.3	57.3